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5 **TRANSMITTAL LETTER AND CERTIFICATE OF MAILING**

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10 The following enumerated items accompany this transmittal letter and are being submitted for the
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- 11 1. Specification—title page, plus 62 pages, including 60 claims and Abstract
12 2. Transmittal letter including Certificate of Express Mailing
13 3. 7 Sheets Formal Drawings (Figs. 1-7)
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR LETTERS PATENT

Selection Services Component For An Extensible Editor

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ATTORNEY'S DOCKET NO. MS1-675US

1 **TECHNICAL FIELD**

2 The systems and methods described herein relate to extensible editors and,
3 more particularly, the described implementations relate to selection services in an
4 extensible editor.

5

6 **BACKGROUND**

7 The process of editing electronic documents generally consists of
8 processing events and key combinations received by an editor. From events and
9 key combinations, an editing space is created. The editing space consists of a
10 document state plus a view state (visual feedback). The view state includes a
11 selection state (what is selected, what is shown as feedback), scroll position, etc.
12 The event interacts with the current state, and an editing model is applied to
13 manipulate feedback or to manipulate the document based on the feedback.

14 Extensible editors typically provide a set of document manipulation
15 services that can enable macros to perform advanced tasks on the content of a
16 document. With an extensible editor, developers can couple extensions that define
17 or re-define a manner in which the editor responds to events or key combinations
18 and provides visual feedback to a user. For example, if a developer wishes to
19 create a new look to a selection process or a highlighting process in an extensible
20 editor, the developer can create an extension that receives input regarding cursor
21 position, cursor movement, mouse actions, etc. The developer can design the
22 extension to use this input to create visual feedback that differs from a default
23 selection service or highlight service of the editor. However, familiar behavior of
24 the editor (such as clicking a “bold” button) is still retained by the editor. In
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1 addition, an extension can also expose virtually any kind of functionality through
2 its own interfaces.

3 Extensible editors are designed so that one or more extensions can be
4 coupled with the editor. This is accomplished by implementing a set of interfaces
5 to which the extensions must conform. The interfaces are utilized by the
6 extensions to access a host of basic functions so that the extensions themselves are
7 not required to implement such basic functions. The extensions instead utilize the
8 basic functions to perform tasks that supplement or override functions performed
9 by the editor.

10 Extensible editors are desirable for their ability to include customer
11 extensions to provide a rich editing experience. A significant part of an editing
12 experience involves the selection model provided by the editor. A user may wish
13 to develop a custom extension that includes a selection process that provides a
14 unique look and feel to the user's editor, that provides selection feedback based on
15 the selected data, and so on.

16 When utilizing extensions in an extensible editor, however, a conflict
17 problem can arise if multiple extensions are used simultaneously that act upon the
18 occurrence of the same event or key combination. If a first extension reacts to an
19 event in one way, but a second extension receives the event after the first extension
20 has acted on it, the second extension may also act on the event and, as a result,
21 override the action of the first extension. This problem can occur even when using
22 only one extension, if the extension acts on an event or key combination but does
23 not prevent the (default) editor from subsequently acting on the same event.

1 **SUMMARY**

2 An extensible editor for editing electronic documents and/or content is
3 described herein. The extensible editor provides a selection services component
4 that allows extensions to interface with a selection model of the editor and provide
5 a custom selection process to the editor. The editor can thereby implement the
6 custom selection process without knowing details of how the selection process is
7 implemented in the extension. The extensible editor (“editor”) includes three sets
8 of interfaces for extension integration.

9 The first set of interfaces is part of a designer extensibility mechanism. The
10 designer extensibility mechanism is used to couple an extension (also called a
11 “designer”) to utilize the event routing model. The designer extensibility
12 mechanism provides the ability to connect an editor extension that can modify
13 editing behavior. An attached designer receives events and key combinations in a
14 predefined order and uses the set of interfaces to create custom editing extensions.

15 The designer extensibility mechanism includes an edit designer interface
16 that has four methods: translate accelerator, pre-handle event, post-handle event
17 and post-event notify. The methods act as callback routines whenever an event
18 occurs in the editing environment of the editor. When an event comes into the
19 editor, the four methods intercept the event at different points of the editor’s event
20 handling process. The editor invokes the methods sequentially. If multiple
21 designers are utilized, the editor invokes the current method on each designer
22 sequentially, in the order in which the designers were registered with the editor.

23 If a designer acts on an event and wants to prevent any subsequent designer
24 (or the editor) from acting on the event, the designer “consumes” the event by

1 returning an appropriate signal to the editor. The designer returns a different
2 signal when subsequent processing is to continue on an event.

3 If an event is a key combination (Ctrl-A, Alt-P, etc.) it first passes through
4 the “translate accelerator” method. This is done in the order that the designers
5 were added to the editor. If a key combination is entered, then the designer acts
6 upon the event and “consumes” the event so that subsequent designers or the
7 default editor cannot subsequently act upon the event.

8 The post-editor event notify method is an exception to the rule that
9 consumed events are not passed on to subsequent designers or the editor for
10 further processing. This method is always called on all designers, regardless of
11 whether, or when, an event is consumed. This allows each designer to clean up
12 any internal states that may be anticipating an event that is consumed before
13 reaching the designer.

14 The second set of interfaces is included in a selection services component
15 of the editor. The selection services component provides designers with the ability
16 to manage logical selections that are used by commands and other extensions, *i.e.*,
17 the ability to modify the logical selection state of the editor. As a result, all editing
18 commands and services will be able to interact with a custom selection model
19 without having detailed knowledge of the designer that is implementing the
20 selection.

21 The third set of interfaces is included in a highlight rendering services
22 component. The highlight rendering component allows a user to modify the
23 rendered character attributes of text without modifying the document content.
24 This facility is critical for providing a mechanism for providing user feedback
25 without affecting persistence, undo, etc.

1 **BRIEF DESCRIPTION OF THE DRAWINGS**

2 A more complete understanding of exemplary methods and arrangements
3 of the present invention may be had by reference to the following detailed
4 description when taken in conjunction with the accompanying drawings wherein:

5 Fig. 1 is an exemplary computer system on which the present invention
6 may be implemented.

7 Fig. 2 is a block diagram of a computer having an extensible editor and
8 several extensions coupled with the editor stored in memory.

9 Fig. 3 is a block diagram of an editor including a designer interface.

10 Fig. 4 is a block diagram of an event routing model utilized in an extensible
11 editor.

12 Fig. 5 is a flow diagram of an event routing model for use in an extensible
13 editor.

14 Fig. 6 is a block diagram of an editor including a selection services
15 interface.

16 Fig. 7 is a block diagram of an editor including a highlighting services
17 interface.

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1 **DETAILED DESCRIPTION**

2 The invention is illustrated in the drawings as being implemented in a
3 suitable computing environment. Although not required, the invention will be
4 described in the general context of computer-executable instructions, such as
5 program modules, to be executed by a computing device, such as a personal
6 computer or a hand-held computer or electronic device. Generally, program
7 modules include routines, programs, objects, components, data structures, etc. that
8 perform particular tasks or implement particular abstract data types. Moreover,
9 those skilled in the art will appreciate that the invention may be practiced with
10 other computer system configurations, including multi-processor systems,
11 microprocessor-based or programmable consumer electronics, network PCs,
12 minicomputers, mainframe computers, and the like. The invention may also be
13 practiced in distributed computing environments where tasks are performed by
14 remote processing devices that are linked through a communications network. In
15 a distributed computing environment, program modules may be located in both
16 local and remote memory storage devices.

17 **Exemplary Computer Environment**

18 The various components and functionality described herein are
19 implemented with a number of individual computers. Fig. 1 shows components of
20 typical example of such a computer, referred by to reference numeral 100. The
21 components shown in Fig. 1 are only examples, and are not intended to suggest
22 any limitation as to the scope of the functionality of the invention; the invention is
23 not necessarily dependent on the features shown in Fig. 1.

Generally, various different general purpose or special purpose computing system configurations can be used. Examples of well known computing systems, environments, and/or configurations that may be suitable for use with the invention include, but are not limited to, personal computers, server computers, hand-held or laptop devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

The functionality of the computers is embodied in many cases by computer-executable instructions, such as program modules, that are executed by the computers. Generally, program modules include routines, programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Tasks might also be performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote computer storage media.

The instructions and/or program modules are stored at different times in the various computer-readable media that are either part of the computer or that can be read by the computer. Programs are typically distributed, for example, on floppy disks, CD-ROMs, DVD, or some form of communication media such as a modulated signal. From there, they are installed or loaded into the secondary memory of a computer. At execution, they are loaded at least partially into the computer's primary electronic memory. The invention described herein includes these and other various types of computer-readable media when such media contain instructions programs, and/or modules for implementing the steps

described below in conjunction with a microprocessor or other data processors. The invention also includes the computer itself when programmed according to the methods and techniques described below.

For purposes of illustration, programs and other executable program components such as the operating system are illustrated herein as discrete blocks, although it is recognized that such programs and components reside at various times in different storage components of the computer, and are executed by the data processor(s) of the computer.

With reference to Fig. 1, the components of computer 100 may include, but are not limited to, a processing unit 120, a system memory 130, and a system bus 121 that couples various system components including the system memory to the processing unit 120. The system bus 121 may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISAA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus also known as the Mezzanine bus.

Computer 100 typically includes a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by computer 100 and includes both volatile and nonvolatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. "Computer storage media" includes both volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of

1 information such as computer-readable instructions, data structures, program
2 modules, or other data. Computer storage media includes, but is not limited to,
3 RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM,
4 digital versatile disks (DVD) or other optical disk storage, magnetic cassettes,
5 magnetic tape, magnetic disk storage or other magnetic storage devices, or any
6 other medium which can be used to store the desired information and which can be
7 accessed by computer 110. Communication media typically embodies computer-
8 readable instructions, data structures, program modules or other data in a
9 modulated data signal such as a carrier wave or other transport mechanism and
10 includes any information delivery media. The term "modulated data signal"
11 means a signal that has one or more if its characteristics set or changed in such a
12 manner as to encode information in the signal. By way of example, and not
13 limitation, communication media includes wired media such as a wired network or
14 direct-wired connection and wireless media such as acoustic, RF, infrared and
15 other wireless media. Combinations of any of the above should also be included
16 within the scope of computer readable media.

17 The system memory 130 includes computer storage media in the form of
18 volatile and/or nonvolatile memory such as read only memory (ROM) 131 and
19 random access memory (RAM) 132. A basic input/output system 133 (BIOS),
20 containing the basic routines that help to transfer information between elements
21 within computer 100, such as during start-up, is typically stored in ROM 131.
22 RAM 132 typically contains data and/or program modules that are immediately
23 accessible to and/or presently being operated on by processing unit 120. By way
24 of example, and not limitation, Fig. 1 illustrates operating system 134, application
25 programs 135, other program modules 136, and program data 137.

1 The computer 100 may also include other removable/non-removable,
2 volatile/nonvolatile computer storage media. By way of example only, Fig. 1
3 illustrates a hard disk drive 141 that reads from or writes to non-removable,
4 nonvolatile magnetic media, a magnetic disk drive 151 that reads from or writes to
5 a removable, nonvolatile magnetic disk 152, and an optical disk drive 155 that
6 reads from or writes to a removable, nonvolatile optical disk 156 such as a CD
7 ROM or other optical media. Other removable/non-removable,
8 volatile/nonvolatile computer storage media that can be used in the exemplary
9 operating environment include, but are not limited to, magnetic tape cassettes,
10 flash memory cards, digital versatile disks, digital video tape, solid state RAM,
11 solid state ROM, and the like. The hard disk drive 141 is typically connected to
12 the system bus 121 through a non-removable memory interface such as interface
13 140, and magnetic disk drive 151 and optical disk drive 155 are typically
14 connected to the system bus 121 by a removable memory interface such as
15 interface 150.

16 The drives and their associated computer storage media discussed above
17 and illustrated in Fig. 1 provide storage of computer-readable instructions, data
18 structures, program modules, and other data for computer 100. In Fig. 1, for
19 example, hard disk drive 141 is illustrated as storing operating system 144,
20 application programs 145, other program modules 146, and program data 147.
21 Note that these components can either be the same as or different from operating
22 system 134, application programs 135, other program modules 136, and program
23 data 137. Operating system 144, application programs 145, other program
24 modules 146, and program data 147 are given different numbers here to illustrate
25 that, at a minimum, they are different copies. A user may enter commands and

1 information into the computer 100 through input devices such as a keyboard 162
2 and pointing device 161, commonly referred to as a mouse, trackball, or touch
3 pad. Other input devices (not shown) may include a microphone, joystick, game
4 pad, satellite dish, scanner, or the like. These and other input devices are often
5 connected to the processing unit 120 through a user input interface 160 that is
6 coupled to the system bus, but may be connected by other interface and bus
7 structures, such as a parallel port, game port, or a universal serial bus (USB). A
8 monitor 191 or other type of display device is also connected to the system bus
9 121 via an interface, such as a video interface 190. In addition to the monitor,
10 computers may also include other peripheral output devices such as speakers 197
11 and printer 196, which may be connected through an output peripheral interface
12 195.

13 The computer may operate in a networked environment using logical
14 connections to one or more remote computers, such as a remote computer 180.
15 The remote computer 180 may be a personal computer, a server, a router, a
16 network PC, a peer device or other common network node, and typically includes
17 many or all of the elements described above relative to computer 100, although
18 only a memory storage device 181 has been illustrated in Fig. 1. The logical
19 connections depicted in Fig. 1 include a local area network (LAN) 171 and a wide
20 area network (WAN) 173, but may also include other networks. Such networking
21 environments are commonplace in offices, enterprise-wide computer networks,
22 intranets, and the Internet.

23 When used in a LAN networking environment, the computer 100 is
24 connected to the LAN 171 through a network interface or adapter 170. When used
25 in a WAN networking environment, the computer 100 typically includes a modem

1 172 or other means for establishing communications over the WAN 173, such as
2 the Internet. The modem 172, which may be internal or external, may be
3 connected to the system bus 121 via the user input interface 160, or other
4 appropriate mechanism. In a networked environment, program modules depicted
5 relative to the computer 100, or portions thereof, may be stored in the remote
6 memory storage device. By way of example, and not limitation, Fig. 1 illustrates
7 remote application programs 185 as residing on memory device 181. It will be
8 appreciated that the network connections shown are exemplary and other means of
9 establishing a communications link between the computers may be used.

10 Fig. 2 is a block diagram of a computer 200 having a processor 202 and
11 memory 204. An extensible editor 206 stored in the memory 204 includes an
12 event routing controller 208, a designer extensibility mechanism 210, a selection
13 services component 212, and a highlight rendering services component 214.
14 Three designers 216, 218, 220 are also stored in the memory 204. Each of the
15 designers 216 - 220 communicates with the editor 206 via the designer
16 extensibility mechanism 210. Each designer 216 - 220, as shown, also
17 communicates with the selection services component 212 and the highlight
18 rendering component 214. It is noted, however, that a designer 216 - 220 may
19 communicate with only the selection services component 212 or the highlight
20 rendering component 214 or with neither. However, as will become clear in the
21 following discussion, each designer 216 - 220 must attach to the editor 206
22 through the designer extensibility mechanism 210.

23 A designer is an editor extension that is used to extend the functionality of
24 the editor 206 and to customize the behavior of the editor 206. While an
25 "extension" is a generic term for a designer, the term "designer" is utilized in

1 several products of the MICROSOFT CORP., such as INTERNET EXPLORER
2 5.5, MSHTML (the HTML parsing and rendering engine of INTERNET
3 EXPLORER that displays a document with editable content), the WebBrowser
4 (ActiveX) control, etc. For purposes of the present discussion, terms specific to
5 one or more of such products will be used. For example, in the present discussion,
6 editor extensions will be referred to as designers. A reference to such a specific
7 term (*e.g.*, designer) is intended to include reference to the more generic term
8 (*e.g.*, extension).

9 The designers 216 - 220 work by intercepting events and commands
10 occurring in, or received by, the editor 206. When one or more of the designers
11 216 - 220 intercepts an event (or command), the designer can change how the
12 editor 206 handles the event. Generally, a designer is written to either supplement
13 or override the editor's behavior. Several designers may be attached to the editor
14 206 at once, thereby dynamically enabling multiple levels of custom functionality.

15 Designers offer a very powerful tool for customizing the editor 206.
16 Virtually any part of the editor's behavior can be changed. For example, designers
17 may be used to add spell checking capability to the editor 206, to add table editing
18 functionality, to add annotation or revision-tracking capability, and so on. It is
19 noted that, although only three designers 216 - 220 are shown in conjunction with
20 the editor 206, any number of designers may be connected to the editor 206.

21 The designer extensibility mechanism 210, the selection services
22 component 212, and the highlight rendering services 214 of the editor 206 shown
23 in Fig. 2 provide specific functionality to the editor 206. Each of the modules and
24 the functionality it provides will be discussed separately, in detail, below.

1 **Designer Extensibility Mechanism**

2 Fig. 3 is a block diagram of an editor 300 similar to the editor 206 shown in
3 Fig. 2. The editor 300 includes a default event handler 301, an event routing
4 controller 302 and a designer registry 303. The editor also includes an edit
5 designer interface 304 that has several methods through which one or more
6 designers (not shown) communicate with the editor 300. Each designer that is
7 coupled with the editor 300 communicates with the editor 300 through the edit
8 designer interface 304. Any coupled designer may then communicate with any
9 other interfaces that are a part of the editor 300.

10 When a designer is added to the editor 300, the designer is registered in the
11 designer registry 303. The event routing controller 302 accesses the designer
12 registry 303 to determine the designers that are coupled to the editor 300. As will
13 be discussed in greater detail below, the event routing controller 302 utilizes the
14 designer registry 303 when routing events to attached designers.

15 The methods of the edit designer interface 304 are a translate accelerator
16 method 306 (TranslateAccelerator), a pre-handle event method 308
17 (PreHandleEvent), a post-handle event method 310 (PostHandleEvent), and a
18 post-editor event notify method 312 (PostEditorEventNotify). Each method 306 -
19 312 has two parameters, an event identifier 314 and an event object interface 316.
20 In one implementation, the event identifier 314 is a value included in
21 HTMLELEMENTEVENTS2 in mshtmdid.h, and the event object interface 316 is
22 anIHTMLEventObj, which enables a designer to obtain more extended
23 information about the event.

24 The methods 306 - 312 act as callback routines whenever an event occurs in
25 the editing environment. In other words, whenever an event occurs that is

1 detected by the editor 300, each of the methods 306 - 312 is called, in a particular
2 sequence, by the editor 300 to process the event. Processing the event may entail
3 providing an external response to the event, responding internally to the event, not
4 responding to the event, consuming the event and/or passing the event for further
5 processing (*i.e.*, not consuming the event).

6 The event routing controller 302 determines when a particular method will
7 be called. If multiple designers are registered with the editor 300 in the designer
8 registry 303, the event routing controller 302 invokes the current method on each
9 designer sequentially, in the order in which the designers were registered with the
10 editor 300. Further explanation of the event routing technique will be explained
11 below with continuing reference to the elements and reference numerals of Fig. 3.

12 Fig. 4 is a block diagram of an event routing model utilized in an extensible
13 editor. In addition to the editor 300 shown in Fig. 3, Fig. 4 includes a first
14 extension, Designer A 320, and a second extension, Designer B 330. Although
15 only two designers 320, 330 are shown, it should be understood that virtually any
16 number of designers may be added to the editor 300. The functionality of the
17 routing mechanism when using more than two designers is similar to the
18 description of the routing mechanism using the two designers 320, 330.

19 The editor 300 is designed to receive notification of an event 400. If the
20 event 400 is a key combination input by a user, then the event routing controller
21 302 routes the event to the translate accelerator method 306. The event 400 is
22 made available to a translation accelerator 306a in Designer A 320. The
23 translation accelerator 306a of Designer A 320 may or may not provide a response
24 to the event 400. If a response is provided to the event 400 by Designer A 320,
25 then Designer A 320 may consume the event 400 to prevent Designer B 330 from

1 overriding the response to the event 400 by Designer A 320. To “consume” an
2 event, a designer returns a value (S_OK) to the editor indicating that no further
3 processing should be done on the event. If Designer A 320 does not respond to
4 the event 400, then the event 400 will be made available to a translation
5 accelerator 306b of Designer B 330. To indicate that an event should continue to
6 be processed, a designer returns a different value to the editor (S_FALSE).
7 Designer B 330 may then respond or not respond to the event 400 in the same way
8 as described for Designer A 320. This process continues with any other designers
9 that may be attached to the editor 300.

10 After each designer 320, 330 has had the opportunity to react to the event
11 400 (unless one of the designers 320, 330 has already consumed the event),
12 control of the event 400 is returned to the event routing controller 302 of the editor
13 300. It is noted that the editor 300 may include its own translate accelerator that
14 is designed to translate the key combination. This translate accelerator could be a
15 part of the default event handler 301. In the preferred implementation, the default
16 event handler 301 will receive the key combination (event 400) if not already
17 consumed by one of the designers 320, 330. The default event handler 301 may or
18 may not be configured to provide a response to the particular key combination. If
19 it is configured to respond to a particular key combination, then an appropriate
20 response is made; if not, then no response will be made to the key combination.

21 It is significant that if Designer B 330 is configured to act on a particular
22 key combination, Designer B 330 may never receive that key combination if
23 Designer A 320 consumes the combination. Therefore, while the implementations
24 described herein significantly improve conflict avoidance in extensible editors,
25 when developing a new designer, careful consideration must be given to the key

1 combinations and events that will trigger actions by a designer. Also, multiple
2 designers can be strategically registered with the editor 300 to avoid this situation.

3 If the event 400 is not a key combination, then the event routing controller
4 makes the event 400 available to the designers 320, 330 via the pre-handle event
5 method 308. Designer A 320 first has the opportunity to respond to the event 400.
6 If Designer A 320 is configured to respond to the event 400, then it provides an
7 appropriate response. After providing a response, Designer A 320 may either
8 consume the event 400 or pass it along.

9 If, for example, Designer A 320 is an “auto correct” designer and Designer
10 B 330 is a grammar checking designer, an event (entry of a word into the
11 document) would be routed first through the auto correct designer to determine if
12 the word should be corrected. After the word is checked (whether or not it is
13 corrected), the grammar checking designer still requires notice of the event to
14 perform its function. Therefore, Designer A 320 would act on the event but still
15 make it available to Designer B 330

16 If the event 400 is not consumed by Designer A 320, then the event 400 is
17 made available to Designer B 330. Designer B 330 has the same options of
18 reacting to the event 400 as described above for Designer A 320. This is true for
19 each subsequent designer attached to the editor 300.

20 After each designer has the opportunity to respond to the event 400 a first
21 time, the event is passed to the default event handler 301 (assuming that the event
22 400 has not been previously consumed by a designer). The default event handler
23 301 then provides the default behavior of the editor 300 in response to the event
24 400. It is noted that if no designers are attached to the editor 300, then the editor
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1 300 will simply provide the default editing behavior via the default event handler
2 301.

3 After the default event handler 301 has acted on the event 400, the
4 designers 320, 330 are provided another opportunity to respond to the event 400.
5 The event 400 is made available to the designers 320, 330 through the post-handle
6 event method 310. The post-handle event processing is similar to the pre-handle
7 event processing, occurring in the sequence in which the designers 320, 330 were
8 registered with the editor 300.

9 By way of example, suppose that a developer wants to implement an “auto
10 correct” designer that listens to key strokes. The designer, in this case, should
11 receive an event after a typed character is inserted into the document (i.e.,
12 PostHandleEvent) rather than before the character is inserted. Receiving the event
13 after the default editor has inserted the character allows the designer to inspect the
14 document with the correct content, allow undo of auto-correct behavior, etc.

15 After the post-handle event processing is concluded, the event 400 is
16 processed by the default handler 301.

17 The post-editor event notify method 312 is called after the editor 300 has
18 finished its post-handling of the event 400 or when a designer 320, 330 has
19 consumed the event. In the case where the event 400 is consumed by a designer
20 320, 330 before a default action takes place and no post-handle event methods are
21 called, a post-editor event notification module 312a, 312b is invoked to give the
22 designers 320, 330 an opportunity to make a final response. For example, suppose
23 a mouse down event starts a selection in a designer that implements basic text
24 selection. If there is a mouse down event, the designer starts the selection. Now,
25 if some other designer consumes the corresponding mouse up event, the designer

1 still needs to know about the mouse up event so it can terminate the selection and
2 stop responding to mouse move events.

3 Fig. 5 is a flow diagram of the preferred implementation of the event
4 routing model described above for use in an extensible editor 300. Continuing
5 reference will be made to the elements and reference numerals of Fig. 2 – Fig. 4 in
6 the description of the flow diagram.

7 At step 500, an event 400 is received by the editor 300. The event routing
8 controller 302 determines if the event 400 is a key combination at step 502. If the
9 event is a key combination (“Yes” branch, step 502), then the key combination is
10 translated at step 504 by the designers (if they are configured to translate the
11 particular command) or by the default event handler 301 if no designer translates
12 the key combination and the editor 300 is configured to do so.

13 If the event is not a key combination (“No” branch, step 502) the editor 300
14 determines if a designer 320, 330 is attached to the editor 300 at step 508. If there
15 is not an attached designer (“No” branch, step 508), the event is processed by the
16 default event handler 301 at step 510. If, however, a designer 320, 330 is attached
17 to the editor 300 (“Yes” branch, step 508), then the event 400 is made available to
18 Designer A 320 for pre-handling at step 512. After Designer A 320 has had the
19 opportunity to act on the event 400, Designer B 330 (“Yes” branch, step 514) has
20 the event 400 made available for processing at step 512. There is no other
21 designer attached (“No” branch, step 514), so the event (if not previously
22 consumed), is passed to the default event handler 301 and processed at step 516.

23 After the event 400 is processed by the default event handler 301 of the
24 editor 300, the event is made available to Designer A 320 for processing at step
25 518. Since there is another designer (Designer B 330) (“Yes” branch, step 520),

1 the event 400 is made available to Designer B 330 for processing at step 518.
2 When there are no more designers to process the event 400 (“No” branch, step
3 520), the event is processed by the default event handler 301 at step 522.

4 It is noted that the above discussion assumes that the event 400 is not
5 consumed by the default event handler 301 or the designers 320, 330 and is
6 processed by each method of the editor 300 and the designers 320, 330. Once an
7 event is consumed, further processing of the event terminates.

8 After the event has been through the pre-handle event method 308 and the
9 post-handle event method 310, the post-editor event notification method 312 is
10 called (step 524). Unless consumed by the default event handler 310 or one of the
11 designers 320, 330, each designer 320, 330 is notified of any response to the event
12 400 from any other module as previously described.

13 **Designer Extensibility Mechanism Interfaces**

14 In addition to the edit designer interface 304 described above, the designer
15 extensibility mechanism 210 includes an edit services interface. In MSHTML, the
16 edit services interface is designated as IHTMLEditServices, used to add or remove
17 edit designers and control the current selection. Although the general descriptions
18 of the designer extensibility mechanism can be applied and implemented in any
19 extensible editor and extensions therefor, for discussion purposes, the described
20 implementation will refer to MICROSOFT MSHTML terminology to describe
21 interfaces exposed by a designer extensibility mechanism to allow extensions to be
22 coupled to properly communicate with an extensible editor. Those skilled in the
23 art will appreciate the functions enabled by the described interfaces to implement
24 custom extensions for the extensible editor.

1 The following are detailed descriptions of the edit designer interface and
2 the edit services interface.

3 **Edit Designer Interface (IHTMLEditDesigner)**

4 The edit designer interface includes the following methods:

5 **TranslateAccelerator**

6 Description: Called by MSHTML to translate a key combination entered
7 by a user into an appropriate command.

8 Syntax:

```
9      HRESULT TranslateAccelerator (  
10         DISPID inEvtDispId,  
11         IHTMLElementObj **pIEventObj
```

12 Parameters:

13 *inEvtDispId*

14 [in] DISPID that specifies the event.

15 *pIEventObj*

16 [in] Pointer to an IHTMLElementObj interface that specifies the
17 event.

18 Return Values:

19 Returns S_OK to indicate that the event has been completely
20 handled and that no further processing should take place, either by
21 other edit designers or the MSHTML Editor. Returns S_FALSE to
22 indicate that other edit designers and the MSHTML Editor should
23 perform their processing this event.

1 **PreHandleEvent**

2 Description: Called by MSHTML before the MSHTML Editor processes
3 an event, so that the designer can provide its own event handling behavior.

4 Syntax:

```
5           HRESULT PreHandleEvent (  
6               DISPID inEvtDispId,  
7               IHTMLElementObj *pIEventObj
```

8 Parameters:

9 *inEvtDispId*

10 [in] DISPID that specifies the event.

11 *pIEventObj*

12 [in] Pointer to an IHTMLElementObj interface that specifies the event.

13 Return Values:

14 Returns S_OK to indicate that the event has been completely
15 handled and that no further processing should take place, either by
16 other edit designers or the MSHTML Editor. Returns S_FALSE to
17 indicate that other edit designers and the MSHTML Editor should
18 perform their pre-event processing.

19 **PostHandleEvent**

20 Description: Called by MSHTML after the MSHTML Editor processes an
21 event, so that the designer can provide its own event handling behavior.

22 Syntax:

```
23           HRESULT PostHandleEvent (   
24               DISPID inEvtDispId,  
25               IHTMLElementObj *pIEventObj
```

1 Parameters:

2 *inEvtDispId*

3 [in] DISPID that specifies the event.

4 *pIEventObj*

5 [in] Pointer to an IHTMLEventObj interface that specifies the
6 event.

7 Return Values:

8 Returns S_OK to indicate that the event has been completely
9 handled and that no further processing should take place, either by other edit
10 designers or the MSHTML Editor. Returns S_FALSE to indicate that other edit
11 designers and the MSHTML Editor should perform their post-event processing.

12 **PostEditorEventNotify**

13 Description: Called by MSHTML after an event has been handled by the
14 MSHTML Editor and any registered edit designers.

15 Syntax:

16 HRESULT PostHandleEvent (

17 DISPID *inEvtDispId*,

18 IHTMLEventObj **pIEventObj*

19 Parameters:

20 *inEvtDispId*

21 [in] DISPID that specifies the event.

22 *pIEventObj*

23 [in] Pointer to an IHTMLEventObj interface that specifies the
24 event.

1 Return Values:

2 Returns S_OK if successful, or an error value otherwise.

3

4 **Edit Services Interface (IHTMLEditServices)**

5 The edit designer interface includes the following methods:

6 **AddDesigner**

7 Description: Registers an IHTMLEditDesigner interface to receive event
8 notification from the editor.

9 Syntax:

```
10      HRESULT AddDesigner (  
11                IHTMLEditDesigner *pIDesigner  
12                );
```

13 Parameters:

```
14                *pIDesigner  
15                [in] Pointer to an IHTMLEditDesigner interface to register  
16      for event notification.
```

17 Return Values:

18 Returns S_OK if successful, or an error value otherwise.

19 **GetSelectionServices**

20 Description: Registers an IHTMLEditDesigner interface to receive event
21 notification from the editor.

22 Syntax:

```
23      HRESULT GetSelectionServices (  
24                IMarkupContainer *p.IContainer
```

1 ISelectionServices ***ppSelSvc*
2);
3
Parameters:
4 **p.IContainer*

5 [in] Pointer to an IMarkupContainer interface for which an
6 ISelectionServices interface is desired.

7 ***ppSelSvc*
8 [out] Address of a pointer to a variable that receives an
9 ISelectionServices interface pointer for the ISelectionServices
10 interface on the editor's selection object.

11 Return Values:

12 Returns S_OK if successful, or an error value otherwise.

13 **MoveToSelectionAnchor**

14 Description: Moves a markup pointer to the location of an anchor for the
15 current selection.

16 Syntax:

17 HRESULT MoveSelectionToAnchor (
18 IMarkupPointer **pIStartAnchor*
19);

20 Parameters:

21 **pIStartAnchor*
22 [in] Pointer to an IMarkupPointer interface to move the
23 location of an anchor for the selection.

24 Return Values:

25 Returns S_OK if successful, or an error value otherwise.

1 **MoveToSelectionEnd**

2 Description: Moves markup pointer to the end of the current selection.

3 Syntax:

4 HRESULT MoveToSelectionEnd (

5 IMarkupPointer **pIEndAnchor*

6);

7 Parameters:

8 **pIEndAnchor*

9 [in] Pointer to an IMarkupPointer interface to move to the end

10 of the current session.

11 Return Values:

12 Returns S_OK if successful, or an error value otherwise.

13 **RemoveDesigner**

14 Description: Unregisters a designer from the editor.

15 Syntax:

16 HRESULT RemoveDesigner (

17 IHTMLEditDesigner **pIDesigner*

18);

19 Parameters:

20 *pIDesigner*

21 [in] Pointer to the IHTMLEditDesigner interface to remove

22 from the event notification queue.

23 Return Values:

24 Returns S_OK if successful, or an error value otherwise.

1 **Selection Services**

2 Selection services provides extensions a way to modify a selection process
3 of an extensible editor to which the designers are coupled. Although the general
4 descriptions of the selection services can be applied and implemented in any
5 extensible editor and extensions therefor, for discussion purposes, the described
6 implementation will refer to MICROSOFT MSHTML terminology to describe
7 interfaces exposed by a selection services component to allow extensions to
8 properly communicate with an extensible editor to utilize the selection services
9 component. Those skilled in the art will appreciate the functions enabled by the
10 described interfaces to implement custom extensions for the extensible editor.

11 Fig. 6 is a block diagram of an extensible editor 600 that includes a
12 designer interface 602, an event routing mechanism 604, and a selection services
13 component 606. The selection services component 606 includes several
14 interfaces: a selection services interface 608 (ISelectionServices), a selection
15 services listener interface 610 (ISelectionServiceListener), an element segment
16 interface 612 (IElementSegment), a segment list interface 614 (ISegmentList), and
17 a segment interface 616 (ISegment). These interfaces 608 – 616 will be discussed
18 in greater detail, below.

19 The role of the selection services interfaces 608 – 616 is to provide
20 designers or other editing extensions with the ability to modify the logical
21 selection state. Consequently, all editing commands and services can interact with
22 a custom selection model without having detailed knowledge of the designer that
23 is implementing the selection.

24 For example, the “bold” command is able to implement the operation of
25 making something bold without having any knowledge of the specifics of a given

1 designer. The command is only aware of what part of the document is selected,
2 and it is configured to make the selected region of the document bold.

3 **Selection Service Interface (ISelectionServices)**

4 The selection services interface 608 provides methods to programmatically
5 clear, add and remove segments from a selection object. The methods include an
6 add element segment method 618 (AddElementSegment), a get markup container
7 method 620 (GetMarkupContainer), a get selection services listener method 622
8 (GetSelectionServicesListener), an add segment method 624 (AddSegment), a
9 remove segment method 626 (RemoveSegment), and a set selection type method
10 628 (SetSelectionType). The following are detailed description of the available
11 selection services interface 608 methods.

12 **AddElementSegment**

13 Description: The add element segment method 618 creates an
14 IElementSegment interface for an element in a markup container and adds the
15 segment to the editable selection.

16 Syntax:

```
17     HRESULT AddElementSegment (  
18         IHTMLElement *pIElement,  
19         IElementSegment **ppISegmentAdded  
20     );
```

21 Parameters:

22 *pIElement

23 [in] Pointer to an IHTMLElement interface that specifies the
24 element to add to the selection.

25 **ppISegmentAdded

1 [out] Address of a pointer to a variable that receives an
2 IElementSegment interface pointer for the element segment
3 added to the selection environment.

4 Return Values:

5 Returns S_OK if successful, or an error value otherwise.

6 **GetMarkupContainer**

7 Description: The get markup container method 620 retrieves the markup
8 container for the current editable selection.

9 Syntax:

```
10                  HRESULT GetMarkupContainer (  
11                      IMarkupContainer **ppIContainer  
12                   );
```

13 Parameters:

```
14                  **ppIContainer  
15                    [out] Address of a pointer to a variable that receives an  
16                    IMarkupContainer interface pointer to the interface for the  
17                    markup container that contains the current editable selection.
```

18 Return Values:

19 Returns S_OK if successful, or an error value otherwise.

20 **GetSelectionServicesListener**

21 Description: The get selection services listener 622 method retrieves an
22 ISelectionServicesListener interface for the current editable selection so that the
23 editor can process certain selection events.

24 Syntax:

```
25                  HRESULT GetSelectionServicesListener (
```

```
1           ISelectionServicesListener **ppISelectionServicesListener  
2       );  
3  
Parameters:  
4           **ppISelectionServicesListener  
5           [out] Address of a pointer to a variable that receives an  
6           ISelectionServicesListener interface pointer to the interface  
7           that the editor will use with the current editable selection.
```

8 Return Values:

9 Returns S_OK if successful, or an error value otherwise.

10 **AddSegment**

11 Description: The add segment method 624 creates an ISegment interface
12 for the content between two markup pointers in a markup container, and adds the
13 segment to the editable selection.

14 Syntax:

```
15     HRETURN AddSegment (  
16         IMarkupPointer *pIStart,  
17         IMarkupPointer *pIEnd,  
18         ISegment **ppISegmentAdded  
19     );
```

20 Parameters:

```
21     *pIStart  
22         [in] Pointer to an IMarkupPointer interface that specifies the  
23         start point for adding the segment.  
24     *pIEnd
```

1 [in] Pointer to an IMarkupPointer interface that specifies the
2 end point for adding the segment.

3 ***ppISegmentAdded*

4 [out] Address of a pointer to a variable that receives an
5 ISegment interface pointer to the interface for the added
6 segment in the selection environment.

7 Return Values:

8 Returns S_OK if successful, or an error value otherwise.

9 **RemoveSegment**

10 Description: The remove segment method 626 (RemoveSegment) removes
11 a segment from the editable selection.

12 Syntax:

```
13                  HRESULT RemoveSegment (  
14                      ISegment *pISegment  
15                      );
```

16 Parameters:

17 **pISegment*

18 [in] Pointer to an ISegment interface that specifies the
19 segment to remove.

20 Return Values:

21 Returns S_OK if successful, or an error value otherwise.

22 **SetSelectionType**

23 Description: The set selection type method 628 (SetSelectionType) sets the
24 selection type and clears any existing selection.

1 Syntax:

```
2            HRESULT SetSelectionType;  
3                    SELECTION_TYPE eType  
4                    ISelectionServicesListener *pIListener  
5                );
```

6 Parameters:

7 *eType*
8 [in] SELECTION_TYPE enumeration that specifies the type
9 of selection to set.

10 **pIListener*
11 [in] Optional. Pointer to an ISelectionServiceListener
12 interface specifying the interface to associate with this
13 selection. Set to NULL if unused. NOTE: Although this
14 parameter is optional, without this parameter, the editor will
15 not be able to restore the selection.

16 Return Values:

17 Returns S_OK if successful, or an error value otherwise.

18

19 Element Segment Interface (IElementSegment)

20 The element segment interface 610 provides methods that control a
21 fragment of HTML markup in the current editable selections that consists of a
22 single element. The element segment interface 612 includes a get element method
23 630 (GetElement), an ‘is primary’ method 632 (IsPrimary), and a set primary
24 method 634 (SetPrimary). To obtain an IElementSegment interface for a fragment

1 of HTML markup representing an element, the
2 ISelectionServices::AddElementSegment method is used.

3 The selection object uses element segments to mark fragments of HTML
4 markup that are whole elements, in particular control elements.

5 **GetElement**

6 Description: The get element method 612 (GetElement) retrieves the
7 element to which this segment refers.

8 Syntax:

```
9     HRESULT GetElement (  
10         IHTMLElement **ppIElement  
11     );
```

12 Parameters:

```
13     **ppIElement  
14         [out] Address of a pointer to a variable that receives an  
15             IHTMLElement interface pointer for the interface  
16             representing the element to which the segment refers.
```

17 Return Values:

18 Returns S_OK if successful, or an error value otherwise.

19 **Is Primary**

20 Description: The is primary method 632 (IsPrimary) determines whether
21 the control element represented by this segment is the primary element of a multi-
22 element selection. The primary element of a multiple selection is typically the
23 first one chosen by a user when a selection was made. The primary element
24 typically has distinctive handles that indicate it is the primary element. For
25

example, the primary element might have white handles while the other elements have black ones).

Syntax:

```
HRESULT IsPrimary (
    BOOL *pfPrimary
);
```

Parameters:

**pfPrimary*
[out] Pointer to a BOOL that receives TRUE if the element is the primary element, or FALSE otherwise.

Return Values:

Returns S_OK if successful, or an error value otherwise.

Set Primary

Description: The set primary method (SetPrimary) sets or unsets a control element as a primary element in a control selection. The primary element of a multiple selection is typically the first one chosen by a user when a selection was made. The primary element typically has distinctive handles that indicate it is the primary element. For example, the primary element might have white handles while the other elements have black ones).

Syntax:

```
HRESULT SetPrimary (
    BOOL fPrimary
);
```

Parameters:

fPrimary

1 [in] BOOL that specifies TRUE to set the element as the
2 primary element, or FALSE to unset it as primary.

3 Return Values:

4 Returns S_OK if successful, or an error value otherwise.

5

6 Segment Interface (ISegment)

7 The segment interface 616 provides a method that creates containers
8 (segments) for fragments of HTML markup in the current editable selection.
9 These segments can include both a range of elements and element fragments. The
10 segment interface 616 includes a get pointers method 636 (GetPointers).

11 **GetPointers**

12 Description: The get pointers method 636 (GetPointers) positions markup
13 pointers at the start and end of the selection segment.

14 Syntax:

```
15                  HRESULT GetPointers (  
16                      IMarkupPointer *pIStart,  
17                      IMarkupPointer *pIEnd  
18                  );
```

19 Parameters:

20 *pIStart*

21 [in] Pointer to an IMarkupPointer interface that specifies the
22 markup pointer to position at the beginning of the segment.

23 *pIEnd*

24 [in] Pointer to an IMarkupPointer interface that specifies the
25 markup pointer to position at the end of the segment.

1 Return Values:

2 Returns S_OK if successful, or an error value otherwise.

3

4 **Segment List Interface (ISegmentList)**

5 The segment list interface 614 provides methods that access information
6 about a list of the segments in the current selection. The segment list interface 614
7 includes a create iterator method 638 (CreateIterator), a get type method 640
8 (GetType), and an 'is empty' method 640 (IsEmpty).

9 **CreateIterator**

10 Description: The create iterator method 638 creates an
11 ISegmentListIterator interface used for traversing the members of a segment list.

12 Syntax:

```
13        HRESULT CreateIterator (  
14            ISegmentListIterator **ppIter  
15            );
```

16 Parameters:

```
17            ppIter  
18            [out] Address of a pointer to a variable that receives an  
19            ISegmentListIterator interface pointer for the newly created  
20            ISegmentListIterator.
```

21 Return Values:

22 Returns S_OK if successful, or an error value otherwise.

23 **GetType**

24 Description: The get type method 640 retrieves the type of the selection.

1 Syntax:

```
2           HRESULT GetType (
3                SELECTION_TYPE *peType
4           );
```

5 Parameters:

```
6           peType
7                [out] Pointer to a variable of type SELECTION_TYPE that
8                receives the selection type value.
```

9 Return Values:

10 Returns S_OK if successful, or an error value otherwise.

11 **IsEmpty**

12 Description: The ‘is empty’ method 642 determines whether the segment
13 list is empty.

14 Syntax:

```
15           HRESULT IsEmpty (
16                BOOL *pfEmpty
17           );
```

18 Parameters:

```
19           pfEmpty
20                [out] Pointer to a variable of type BOOL that receives TRUE
21                if the segment list is empty, or FALSE if it is not empty.
```

22 Return Values:

23 Returns S_OK if successful, or an error value otherwise.

1 Selection Services Listener Interface (ISelectionServicesListener)

2 The selection services listener interface 610 provides methods that the
3 editing component of MSHTML calls whenever certain events fire for a selection
4 object that has a registered ISelectionServicesListener interface. This interface
5 provides processing for undo events, for selection type changes, and whenever the
6 mouse pointer exits the scope of an element in the editable selection. An
7 application should supply an implementation of this interface for a selection object
8 so that the editing component of MSHTML can respond to these events. The
9 selection services listener interface 610 includes a begin selection undo method
10 (BeginSelectionUndo) 644, an end selection undo method 646
11 (EndSelectionUndo), a get type detail method 648 (GetTypeDetail), an ‘on change
12 type’ method 650 (OnChangeType), and an ‘on selected element exit’ method 652
13 (OnSelectedElementExit). To register an ISelectionServicesListener interface for
14 a particular selection object, the ISelectionServices::SetSelectionType method or
15 ISelectionServices::OnChangeType method is used.

16 **BeginSelectionUndo**

17 Description: The begin selection undo method 644 is called by the editor
18 600 when an editing operation is beginning that may result in a change in selection
19 after the editing operation. This method exists so that the designers may place
20 their own units on an Undo queue so that a selection may be restored to its original
21 state when the editing process was started.

22 Syntax:

23 HRESULT BeginSelectionUndo (VOID);

24 Parameters:

25 None.

1 Return Values:

2 Returns S_OK if successful, or an error value otherwise.

3 **EndSelectionUndo**

4 Description: The end selection undo method 644 is called by the editor 600
5 at the end of an editing operation that may result in a change in selection after the
6 editing operation. This method exists so that the designers may place their own
7 units on an Undo Queue so that a selection may be restored to its original state
8 when the editing process was started.

9 Syntax:

10 HRESULT EndSelectionUndo (VOID);

11 Parameters:

12 None.

13 Return Values:

14 Returns S_OK if successful, or an error value otherwise.

15 **GetTypeDetail**

16 Description: The get type detail method 648 is called by MSHTML to
17 obtain the name of the selection type. This method allows a host application to
18 provide the name of a selection type when implementing a custom selection
19 mechanism. MSHTML will return a value of 'undefined' if the host does not
20 implement this method.

21 Syntax:

22 HRESULT GetTypeDetail (
23 BSTR **pTypeDetail*
24);
25

1 Parameters:
2 *pTypeDetail*
3 [out] BSTR that specifies the name of the selection type.

4 Return Values:

5 Returns S_OK if successful, or an error value otherwise.

6 **OnChangeType**

7 Description: The ‘on change type’ method 650 is called by the editor 600
8 when the type of a selection changes. This method is used to implement custom
9 processing that should take place when a selection is initiated or when a selection
10 changes type.

11 Syntax:

12 HRESULT OnChangeType (

13 SELECTION_TYPE *eType*,

14 ISelectionServicesListerner **pIListener*

15);

16 Parameters:

17 *eType*

18 [in] SELECTION_TYPE enumeration that specified the new
19 selection type.

20 *pIListener*

21 [in] Optional. Pointer to an ISelectionServicesListener
22 interface to register with the new selection. Can be set to
23 NULL.

24 Return Values:

25 Returns S_OK if successful, or an error value otherwise.

1 **OnSelectedElementExit**

2 Description: The ‘on selected element’ exit method 652 is called by the
3 editor 600 whenever an element that intersects selection undo is removed from the
4 document. This method exists so that the selection can be updated by the
5 extensible editor (either removed or adjusted).

6 Syntax:

7 HRESULT OnSelectedElementExit (

8 IMarkupPointer **pIElementStart*,

9 IMarkupPointer **pIElementEnd*,

10 IMarkupPointer **pIElementContentStart*,

11 IMarkupPointer **pIElementContentEnd*

12);

13 Parameters:

14 **pIElementStart*

15 [in] Pointer to an IMarkupPointer interface specifying the
16 point just before the element’s opening tag.

17 **pIElementEnd*

18 [in] Pointer to an IMarkupPointer interface specifying the
19 point just after the element’s closing tag.

20 **pIElementContentStart*

21 [in] Pointer to an IMarkupPointer interface specifying the
22 point just after the element’s opening tag.

23 **pIElementContentEnd*

24 [in] Pointer to an IMarkupPointer interface specifying the
25 point just before the element’s closing tag.

1 Return Values:

2 Returns S_OK if successful, or an error value otherwise.

3

4 **Highlight Rendering Services**

5 Highlight rendering services allows a user to modify the rendered character
6 attributes of text without modifying the document content. This facility is critical
7 for providing a mechanism for providing user feedback without modifying the
8 document content. This component is critical for providing a mechanism for
9 providing user feedback without affecting persistence, undo, etc.

10 Fig. 7 is a block diagram of an extensible editor 700 that includes a
11 designer interface 702, an event routing mechanism 704, and a highlight rendering
12 services component 706. The highlight rendering services component 706
13 includes two interfaces: a highlight services interface 708
14 (IHighlightRenderingServices), and a highlight segment interface 710
15 (IHighlightSegment). These interfaces 708, 710 will be discussed in greater detail,
16 below.

17 **Highlight Rendering Services Interface (IHighlightRenderingServices)**

18 The highlight rendering services interface 708 provides methods that enable
19 a designer to control which sections of a document are highlighted on the screen
20 and the style of highlighting. The methods include an add segment method 712
21 (AddSegment), a move segment to pointers method 714
22 (MoveSegmentToPointers), and a remove segment method 716
23 (RemoveSegment). The following are detailed description of the available
24 selection services interface 608 methods.

1 **AddSegment**

2 Description: The add segment method 712 creates a highlight segment for
3 the markup between two display pointers and highlights it according to a specified
4 rendering style.

5 Syntax:

6 HRESULT AddSegment (

7 IDisplayPointer **pDispPointerStart*,

8 IDisplayPointer **pDispPointerEnd*,

9 IHTMLRenderStyle **pIRenderStyle*,

10 IHighlightSegment ***ppISegment*

11);

12 Parameters:

13 *pDispPointerStart*

14 [in] Pointer to an IDisplayPointer interface representing the
15 start point of the segment to be highlighted.

16 *pDispPointerEnd*

17 [in] Pointer to an IDisplayPointer interface representing the
18 end point of the segment to be highlighted.

19 *pIRenderStyle*

20 [in] Pointer to an IHTMLRenderStyle interface representing
21 the style with which to render the specified segment.

22 *ppISegment*

23 [out] Address of a pointer to a variable that receives an
24 IHighlightSegment interface pointer for the interface that

1 represents the highlight segment between pDispPointerStart
2 and pDispPointerEnd.

3 Return Values:

4 Returns S_OK if successful, or an error value otherwise.

5 **MoveSegmentToPointers**

6 Description: The move segments to pointers method 714 redefines a
7 highlight segment and its style.

8 Syntax:

```
9                   HRESULT MoveSegmentToPointers (  
10                    IHighlightSegment *pISegment,  
11                    IDisplayPointer *pDispPointerStart,  
12                    IDisplayPointer *pDispPointerEnd  
13                   );
```

14 Parameters:

15 *pISegment*

16 [in] Pointer to an IHighlightSegment interface to redefine.

17 *pIDispPointerStart*

18 p[in] Pointer to an IDisplayPointer interface for the new start
19 point of the highlight segment.

20 *pIDispPointerEnd*

21 [in] Pointer to an IDisplayPointer interface for a new endpoint
22 of the highlight segment.

23 Return Values:

24 Returns S_OK if successful, or an error value otherwise.

1 **RemoveSegment**

2 Description: The remove segment method 716 removes a highlight
3 segment from a collection of segments that are highlighted.

4 Syntax:

5 HRESULT RemoveSegment (

6 IHighlightSegment **pISegment*

7);

8 Parameters:

9 *pISegment*

10 [in] Pointer to an IHighlightSegment interface to remove.

11 Return Values:

12 Returns S_OK if successful, or an error value otherwise.

14 Highlight Segment Interface (IHighlightSegment)

15 The highlight segment interface 710 enables a user to control a highlighted
16 section of a document. This interface does not provide any methods of its own
17 beyond those available from its parent interface, ISegment.

18 Description: The highlight segment interface 710 provides type checking
19 for the segments added or moved from the highlighted sections through the
20 IHighlightRenderingServices interface.

21 Remarks: This interface does not provide any methods of its own beyond
22 those available from its parent interface, ISegment.

1 **Conclusion**

2 The services described above provide an applications program interface
3 (API) for an extensible editor (MSHTML). The interfaces and the methods
4 associated with each interface are summarized as follows:

5 **IHTMLEditServices**

6 AddDesigner
7 GetSelectionServices
8 MoveToSelectionAnchor
9 MoveToSelectionEnd
10 RemoveDesigner

11 **IHTMLEditDesigner**

12 TranslateAccelerator
13 PreHandleEvent
14 PostHandleEvent
15 PostEditorEventNotify

16 **ISelectionServices**

17 AddElementSegment
18 GetMarkupContainer
19 GetSelectionServicesListener
20 AddSegment
21 RemoveSegment
22 SetSelectionType

23 **ISelectionServicesListener**

24 BeginSelectionUndo
25 EndSelectionUndo
26 GetTypeDetail
27 OnChangeType
28 OnSelectedElementExit

29 **ISegmentList**

30 CreateIterator
31 GetType
32 IsEmpty

33 **ISegment**

34 **IElementSegment**

35 GetElement
36 IsPrimary
37 SetPrimary

38 **IHighlightRenderingServices**

39 AddSegment
40 MoveSegmentToPointers
41 RemoveSegment

42 **IHighlightSegment**

1 The interfaces can be utilized by an extension that is coupled with the
2 extensible editor to add new features to the editor, to augment existing features, or
3 to override the editor's default behavior. Extensions can be used to modify the
4 editor to provide customized feedback and to present a rich editing experience to a
5 user.

6 Although details of specific implementations and embodiments are
7 described above, such details are intended to satisfy statutory disclosure
8 obligations rather than to limit the scope of the following claims. Thus, the
9 invention as defined by the claims is not limited to the specific features described
10 above. Rather, the invention is claimed in any of its forms or modifications that
11 fall within the proper scope of the appended claims, appropriately interpreted in
12 accordance with the doctrine of equivalents.

1 **CLAIMS**

2 1. In an electronic document editor, a selection services component
3 comprising a selection services interface that provides one or more methods to
4 enable an editor extension to clear, add or remove a segment from a selection
5 object.

6

7 2. The selection services component as recited in claim 1, wherein one
8 of the methods provided further comprises a method that adds an element segment
9 to an editable selection.

10

11 3. The selection services component as recited in claim 1, wherein one
12 of the methods provided further comprises a method that retrieves an interface for
13 a current editable selection which enables the editor to process certain selection
14 events.

15

16 4. The selection services component as recited in claim 1, wherein one
17 of the methods provided further comprises a method that adds a segment to an
18 editable selection.

19

20 5. The selection services component as recited in claim 1, wherein one
21 of the methods provided further comprises a method that removes a segment from
22 an editable selection.

1 6. The selection services component as recited in claim 1, wherein one
2 of the methods provided further comprises a method that sets a selection type.
3

4 7. In an electronic document editor, a selection services component
5 comprising a selection services listener interface that provides one or more
6 methods that are called by the editor when certain events occur for a selection
7 object that has a registered selection services listener interface.
8

9 8. The selection services component as recited in claim 7, wherein one
10 of the methods that is provided further comprises a BeginSelectionUndo method
11 that is called at the beginning of an editing operation that may result in a change in
12 selection after the editing operation is completed.
13

14 9. The selection services component as recited in claim 7, wherein one
15 of the methods that is provided further comprises an EndSelectionUndo method
16 that is called at the beginning of an editing operation that may result in a change in
17 selection after the editing operation is completed.
18

19 10. The selection services component as recited in claim 7, wherein one
20 of the methods that is provided further comprises a method that provides the editor
21 with the name of a selection type.
22
23
24
25

1 **11.** The selection services component as recited in claim 7, wherein one
2 of the methods that is provided further comprises a method that is used by a
3 designer to implement custom processing when a type of a selection changes.
4

5 **12.** The selection services component as recited in claim 7, wherein one
6 of the methods that is provided further comprises a method that is called by the
7 editor whenever an element that intersects a selection is removed from a document
8 to allow a designer to update the selection.
9

10 **13.** In an electronic document editor, a selection services component
11 comprising an element segment interface that provides one or more methods that
12 enable a designer to control a fragment of markup in a current editable selection
13 that consists of a single element.
14

15 **14.** The selection services component as recited in claim 13, wherein
16 one of the methods that is provided further comprises a method that retrieves an
17 element referred to in the method by a designer.
18

19 **15.** The selection services component as recited in claim 13, wherein
20 one of the methods that is provided further comprises a method that determines
21 whether a control element designated in the method by a designer is a primary
22 element of a multi-element selection.
23
24
25

1 **16.** The selection services component as recited in claim 13, wherein
2 one of the methods that is provided further comprises a method that sets or unsets
3 a control element in a control selection as a primary element.

4

5 **17.** In an electronic document editor, a selection services component
6 comprising a segment list interface that provides one or more methods that enable
7 a designer to access information about a list of document segments in a current
8 selection.

9

10 **18.** The selection services component as recited in claim 17, wherein
11 one of the methods that is provided further comprises a method that creates an
12 interface used by a designer to traverse members of a segment list.

13

14 **19.** The selection services component as recited in claim 17, wherein
15 one of the methods that is provided further comprises a method that enables a
16 designer to retrieve a type of a selection.

17

18 **20.** The selection services component as recited in claim 17, wherein
19 one of the methods that is provided further comprises a method that enables a
20 designer to determine whether a segment list is empty.

1 **21.** In an electronic document editor, a selection services component
2 comprising a segment interface that provides one or more methods that enable a
3 designer to create segments for fragments of HTML markup in a current editable
4 selection.

5

6 **22.** The selection services component as recited in claim 21, wherein
7 one of the methods that is provided further comprises a method that positions
8 markup pointers at a start and end of a selection segment.

9

10 **23.** A computer-readable medium having computer-executable
11 instructions for one or more interfaces that, when executed by an electronic
12 document editor on a computer, perform the following steps:

13 receiving parameters from a designer through a selection services interface;
14 utilizing the parameters to clear, add or remove a selected segment from a
15 selection object of an electronic document;

16 returning values to the designer regarding the state of the selected segment.

17

18 **24.** The computer-readable medium as recited in claim 23, wherein the
19 utilizing the parameters further comprises utilizing the parameters to add an
20 element segment to an editable selection.

1 **25.** The computer-readable medium as recited in claim 23, wherein the
2 utilizing the parameters further comprises utilizing the parameters to retrieve an
3 interface for a current editable selection which enables the editor to process certain
4 selection events.

5

6 **26.** The computer-readable medium as recited in claim 23, wherein the
7 utilizing the parameters further comprises utilizing the parameters to add a
8 segment to an editable selection.

9

10 **27.** The computer-readable medium as recited in claim 23, wherein the
11 utilizing the parameters further comprises utilizing the parameters to remove a
12 segment from an editable selection.

13

14 **28.** The computer-readable medium as recited in claim 23, wherein the
15 utilizing the parameters further comprises utilizing the parameters to set a
16 selection type.

17

18 **29.** A computer-readable medium having computer-executable
19 instructions for one or more interfaces that, when executed by an electronic
20 document editor on a computer, perform the following steps:

21 receiving parameters from a designer through an element segment interface;
22 utilizing the parameters to control a fragment of markup in a current
23 editable selection that consists of a single element;
24 returning values to the designer regarding the fragment of markup.

1
2 **30.** The computer-readable medium as recited in claim 29, wherein the
3 utilizing the parameters further comprises utilizing the parameters to retrieve an
4 element referred to in the method by a designer.
5

6 **31.** The computer-readable medium as recited in claim 29, wherein the
7 utilizing the parameters further comprises utilizing the parameters to determine
8 whether a control element designated in the method by a designer is a primary
9 element of a multi-element selection.
10

11 **32.** A computer-readable medium having computer-executable
12 instructions for one or more interfaces that, when executed by an electronic
13 document editor on a computer, perform the following steps:
14

15 receiving parameters from a designer through a segment list interface;
16 utilizing the parameters to access information about a list of document
17 segments in a current selection.;
18 returning values to the designer regarding the information.
19

20 **33.** The computer-readable medium as recited in claim 29, wherein the
21 utilizing the parameters further comprises utilizing the parameters to create an
22 interface used by a designer to traverse members of a segment list.
23
24
25

1 **34.** The computer-readable medium as recited in claim 29, wherein the
2 utilizing the parameters further comprises utilizing the parameters to retrieve a
3 type of a selection to provide to the designer.

4

5 **35.** The computer-readable medium as recited in claim 29, wherein the
6 utilizing the parameters further comprises utilizing the parameters to determine
7 whether a segment list is empty.

8

9 **36.** A method for providing selection services to one or more extensions
10 in an extensible editor, the method comprising:

11 receiving a request from an extension to utilize a selection services
12 component;

13 facilitating the request by presenting a selection services interface that is
14 accessible by the extension; and

15 communicating with the extension through the selection services interface
16 to enable the extension to clear, add or remove a selected segment from a selection
17 object of an electronic document.

18

19 **37.** The method as recited in claim 36, wherein the selection services
20 interface further comprises a method to add an element segment to an editable
21 selection, and wherein the communicating further comprises communicating with
22 the extension through the selection services interface.

1 **38.** The method as recited in claim 36, wherein the selection services
2 interface further comprises a method to retrieve an interface for a current editable
3 selection which enables the editor to process certain selection events, and wherein
4 the communicating further comprises communicating with the extension through
5 the selection services interface.

6

7 **39.** The method as recited in claim 36, wherein the selection services
8 interface further comprises a method to add a segment to an editable selection, and
9 wherein the communicating further comprises communicating with the extension
10 through the selection services interface.

11

12 **40.** The method as recited in claim 36, wherein the selection services
13 interface further comprises a method to remove a segment from an editable
14 selection, and wherein the communicating further comprises communicating with
15 the extension through the selection services interface.

16

17 **41.** The method as recited in claim 36, wherein the selection services
18 interface further comprises a method to set a selection type, and wherein the
19 communicating further comprises communicating with the extension through the
20 selection services interface.

1 **42.** A method for providing selection services to one or more extensions
2 in an extensible editor, the method comprising:

3 receiving a request from an extension to utilize a selection services
4 component;

5 facilitating the request by presenting a selection services listener interface
6 that is accessible by the extension and that includes methods that are called by the
7 editor when certain events occur for a selection object that has a registered
8 selection services listener interface; and

9 communicating with the extension through the selection services listener
10 interface.

11
12 **43.** The method as recited in claim 42, wherein the selection services
13 listener interface further comprises a BeginSelectionUndo method that is called at
14 the beginning of an editing operation that may result in a change in selection after
15 the editing operation is completed.

16
17 **44.** The method as recited in claim 42, wherein the selection services
18 listener interface further comprises an EndSelectionUndo method that is called at
19 the beginning of an editing operation that may result in a change in selection after
20 the editing operation is completed.

21
22 **45.** The method as recited in claim 42, wherein the selection services
23 listener interface further comprises a method that provides the editor with the
24 name of a selection type.

1 **46.** The method as recited in claim 42, wherein the selection services
2 listener interface further comprises a method that is used by a designer to
3 implement custom processing when a type of a selection changes.

4

5 **47.** The method as recited in claim 42, wherein the selection services
6 listener interface further comprises a method that is called by the editor whenever
7 an element that intersects a selection is removed from a document to allow a
8 designer to update the selection.

9

10 **48.** A method for providing selection services to one or more extensions
11 in an extensible editor, the method comprising:

12 receiving a request from an extension to utilize a selection services
13 component;

14 facilitating the request by presenting an element segment interface that is
15 accessible by the extension and that includes methods that enable the extension to
16 control a fragment of markup in a current editable selection that consists of a
17 single element; and

18 communicating with the extension through the element segment interface.

19

20 **49.** The method as recited in claim 48, wherein the element segment
21 interface further comprises a method that retrieves an element referred to in the
22 method by a designer.

1 **50.** The method as recited in claim 48, wherein the element segment
2 interface further comprises a method that determines whether a control element
3 designated in the method by a designer is a primary element of a multi-element
4 selection.

5
6 **51.** The method as recited in claim 48, wherein the element segment
7 interface further comprises a method that sets or unsets a control element in a
8 control selection as a primary element.

9
10 **52.** A method for providing selection services to one or more extensions
11 in an extensible editor, the method comprising:

12 receiving a request from an extension to utilize a selection services
13 component;

14 facilitating the request by presenting a segment list interface that is
15 accessible by the extension and that includes methods that enable the extension to
16 access information about a list of document segments in a current selection; and

17 communicating with the extension through the segment list interface.

18
19 **53.** The method as recited in claim 52, wherein the segment list
20 interface further comprises a method that creates an interface used by a designer to
21 traverse members of a segment list.

1 **54.** The method as recited in claim 52, wherein the segment list
2 interface further comprises a method that enables a designer to retrieve a type of a
3 selection.

4

5 **55.** The method as recited in claim 52, wherein the segment list
6 interface further comprises a method that enables a designer to determine whether
7 a segment list is empty.

8

9 **56.** An electronic document editor stored on a computer-readable
10 medium, comprising:

11 a designer interface to transfer data between the editor and one or more
12 designers attached to the editor;

13 an event routing controller to route events received by the editor to the one
14 or more designers;

15 a selection services component that is configured to provide an extension
16 with a way to modify a selection process of the editor to which the designers are
17 coupled.

18

19 **57.** The electronic document editor as recited in claim 56, wherein the
20 highlight rendering services component further comprises a selection services
21 interface configured to enable a designer to clear, add or remove a segment from a
22 selection object.

1 **58.** The electronic document editor as recited in claim 56, wherein the
2 highlight rendering services component further comprises a selection services
3 listener interface that is accessible by the extension and that includes methods that
4 are called by the editor when certain events occur for a selection object that has a
5 registered selection services listener interface.

6

7 **59.** The electronic document editor as recited in claim 56, wherein the
8 highlight rendering services component further comprises an element segment
9 interface that is accessible by the extension and that includes methods that enable
10 the extension to control a fragment of markup in a current editable selection that
11 consists of a single element.

12

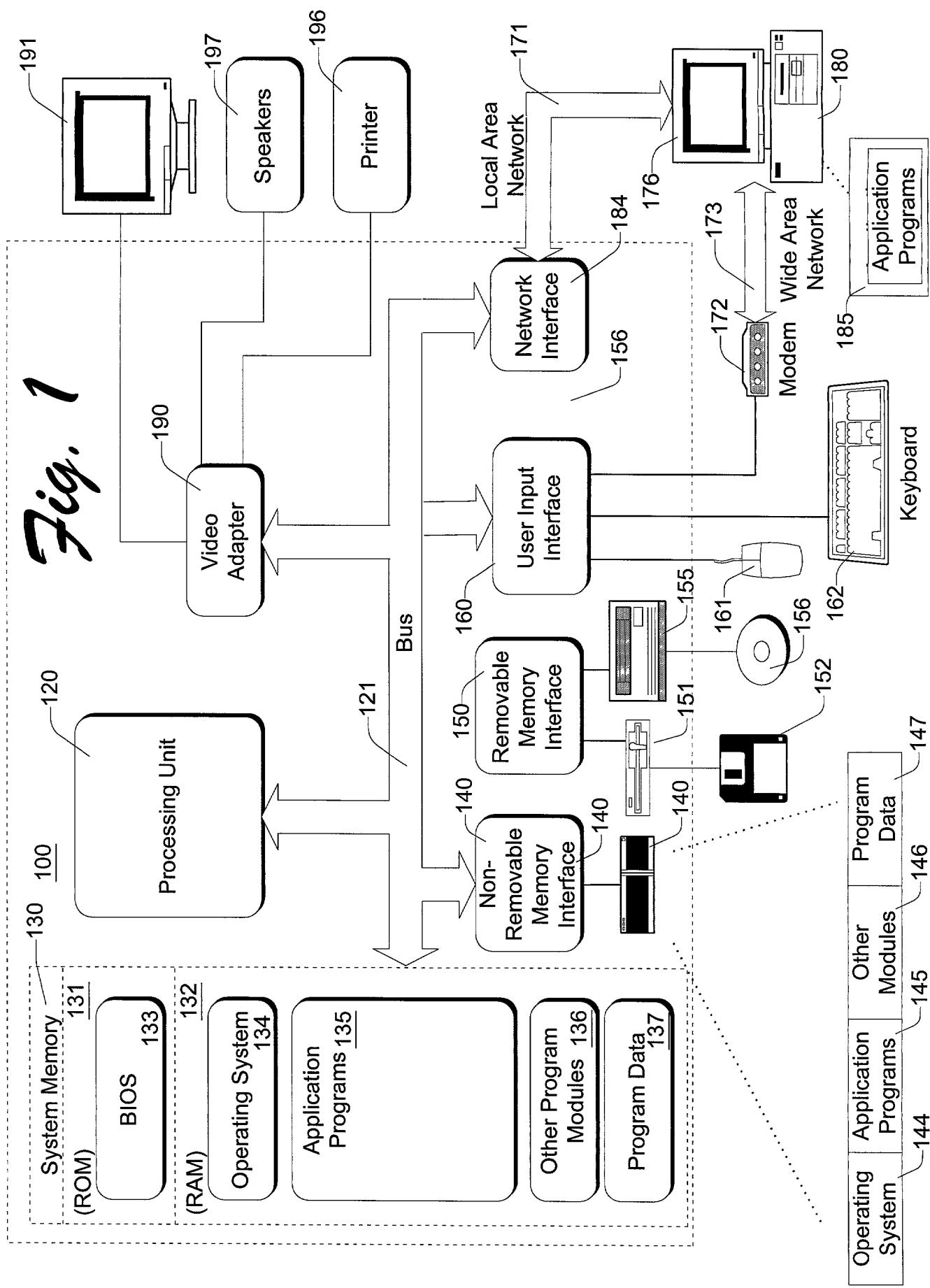
13 **60.** The electronic document editor as recited in claim 56, wherein the
14 highlight rendering services component further comprises a segment list interface
15 that is accessible by the extension and that includes methods that enable the
16 extension to access information about a list of document segments in a current
17 selection.

1 **ABSTRACT**

2 An extensible editor allows integration of extensions that modify the
3 editor's default behavior and provide customized feedback to users. The editor
4 includes interfaces through which extensions are connected to the editor and
5 through which selection services and highlight rendering services are provided.
6 The selection services interfaces provide a clear separation of a logical selection
7 position in the document and the visual feedback provided for the selection,
8 allowing extensions to be designed that provide customized selection feedback.
9 The highlight rendering services interfaces provide an extension with the ability to
10 augment an existing selection without modifying the actual document.

11 The editor also includes an event routing model that works to decrease the
12 occurrence of conflicts between the editor and extensions and between extensions.
13 Upon the occurrence of an event, the editor routes the event to each extension
14 before the editor's default handling of the event occurs. When an extension
15 responds to an event, the extension may "consume" the event by indicating to the
16 editor not to allow further processing of the event. After an event has been pre-
17 processed by each extension, the default editor acts on the event. The editor then
18 routes the event to each extension again, to allow each extension to process the
19 event after the default editor has acted. When the post-processing is completed,
20 each extension is notified of the actions taken by the editor and by each of the
21 other extensions.

Fig. 1



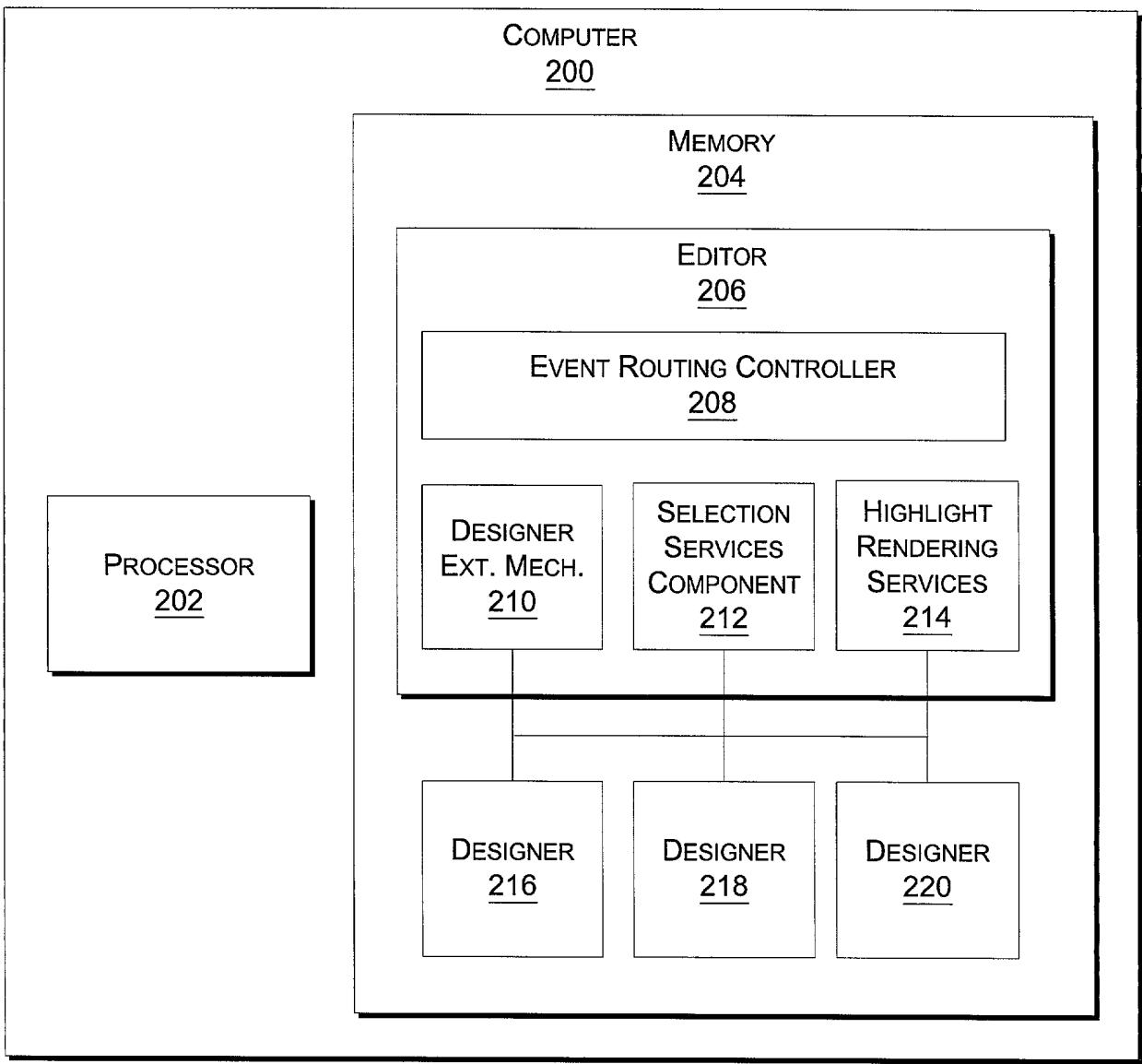


Fig. 2

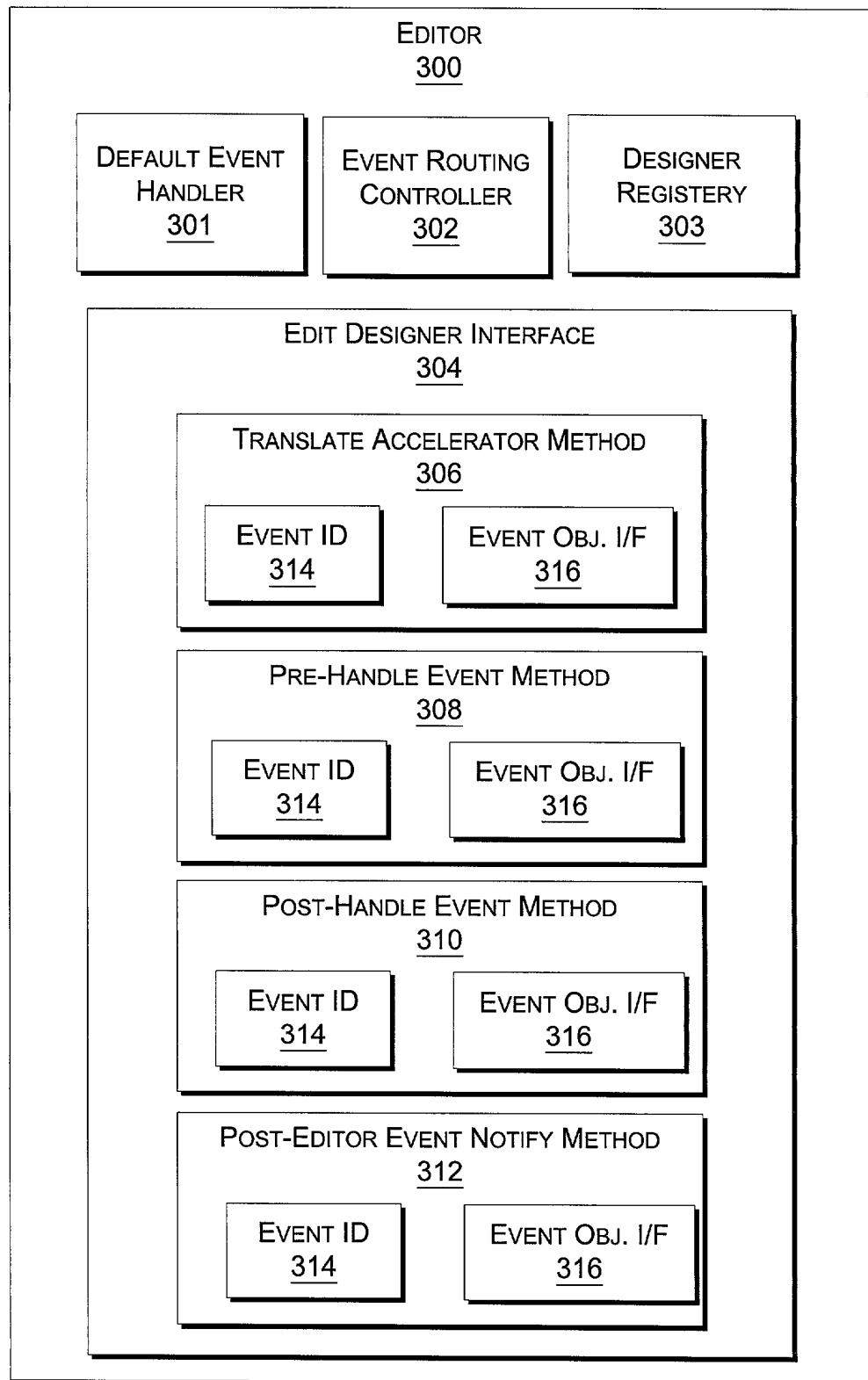


Fig. 3

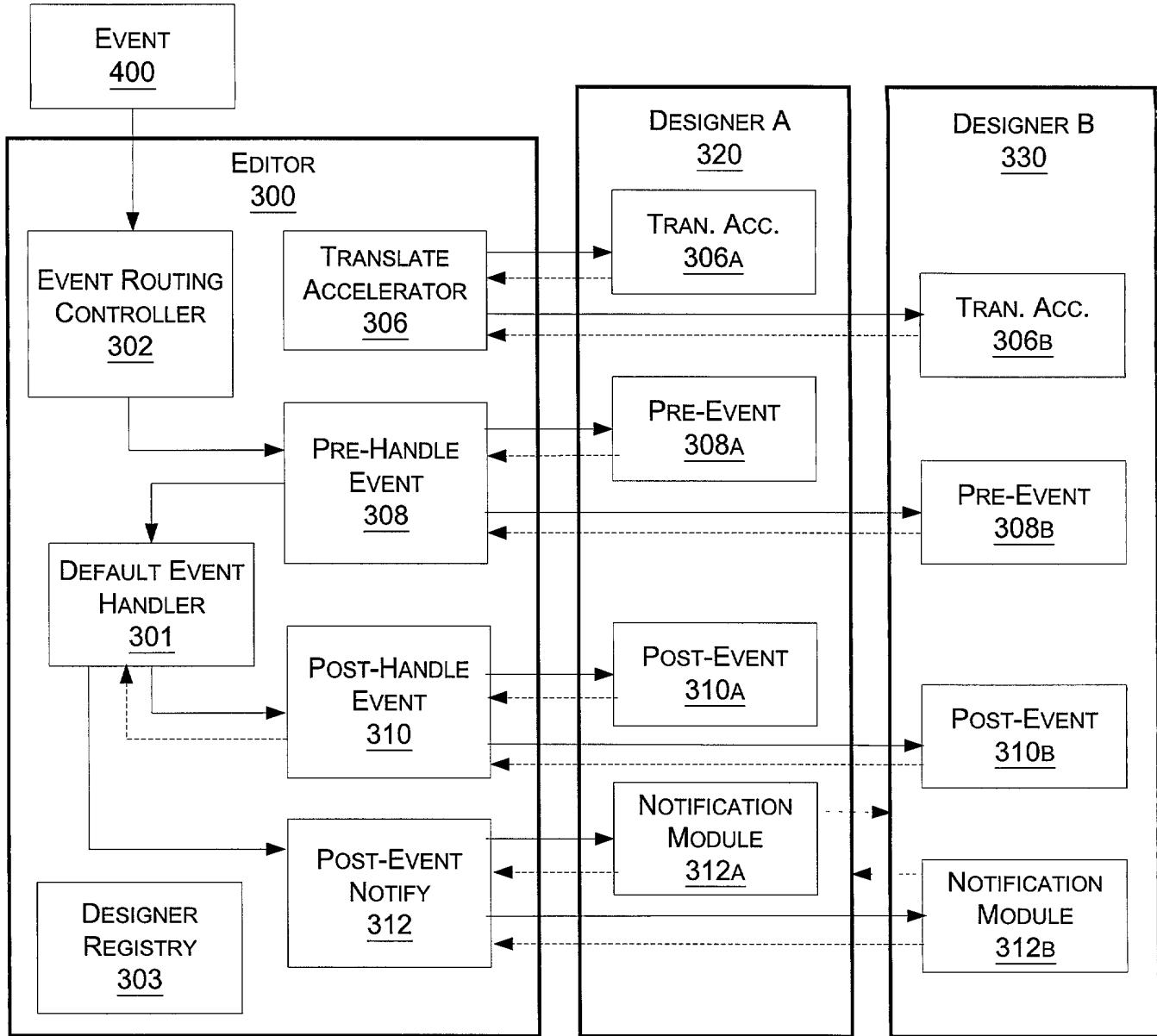


Fig. 4

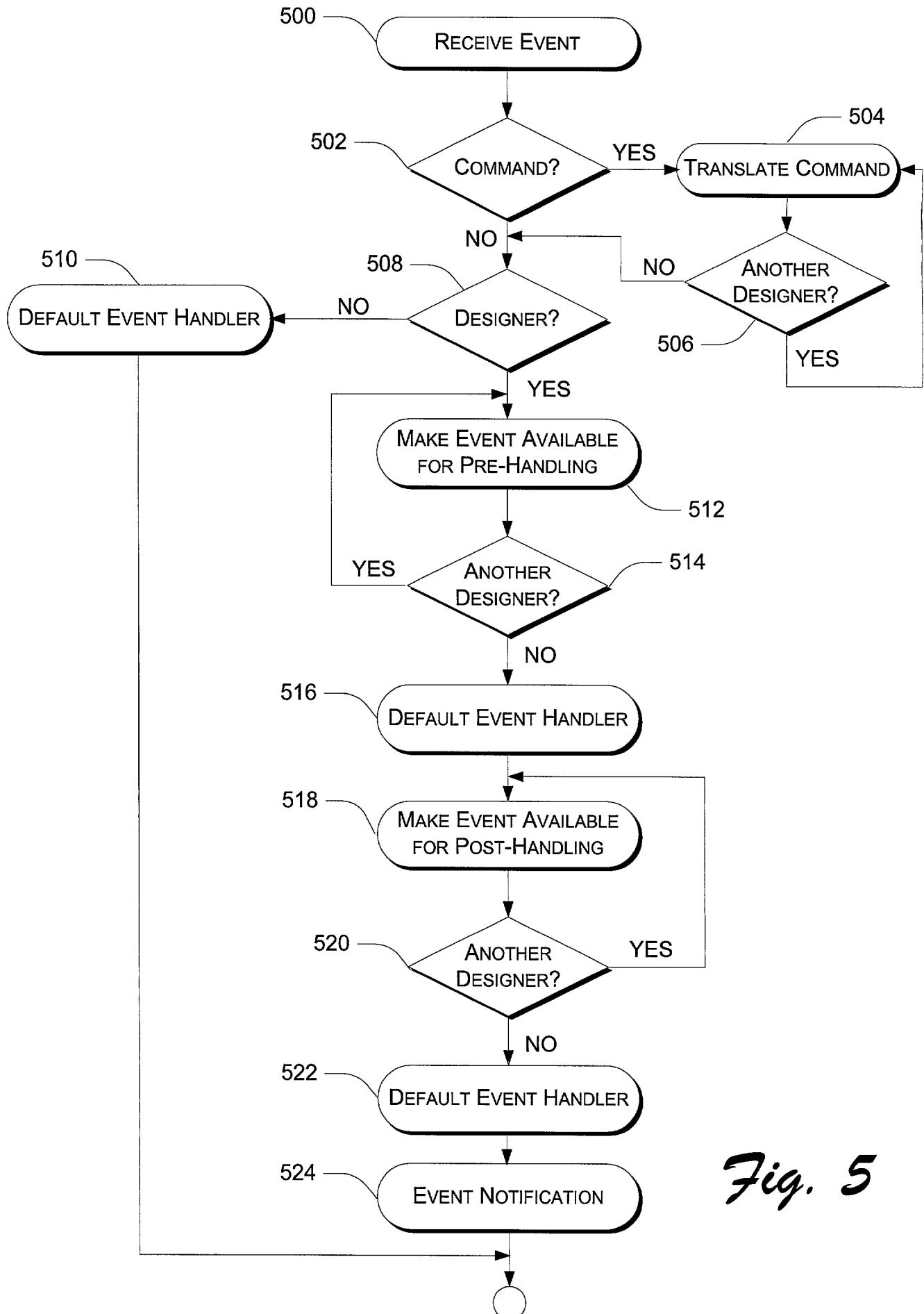


Fig. 5

DESIGNER INTERFACE
602

EDITOR
600

EVENT ROUTING CONTROLLER
604

SELECTION SERVICES
INTERFACE
608

ADD ELEMENT
SEGMENT
618

GET MARKUP
CONTAINER
620

GET SELECTION
SERVICES
LISTENER
622

ADD SEGMENT
624

REMOVE
SEGMENT
626

SET SELECTION
TYPE
628

SELECTION SERVICES
606

SELECTION SERVICES
LISTENER INTERFACE
610

BEGIN SELECTION
UNDO
644

END SELECTION
UNDO
646

GET TYPE DETAIL
648

ON CHANGE
TYPE
650

ON SELECTED
ELEMENT EXIT
652

ELEMENT SEGMENT
INTERFACE
612

GET ELEMENT
630

IS PRIMARY
632

SET PRIMARY
634

SEGMENT LIST
INTERFACE
614

CREATE ITERATOR
638

GET TYPE
640

IS EMPTY
642

SEGMENT INTERFACE
616

GET POINTERS
636

Fig. 6

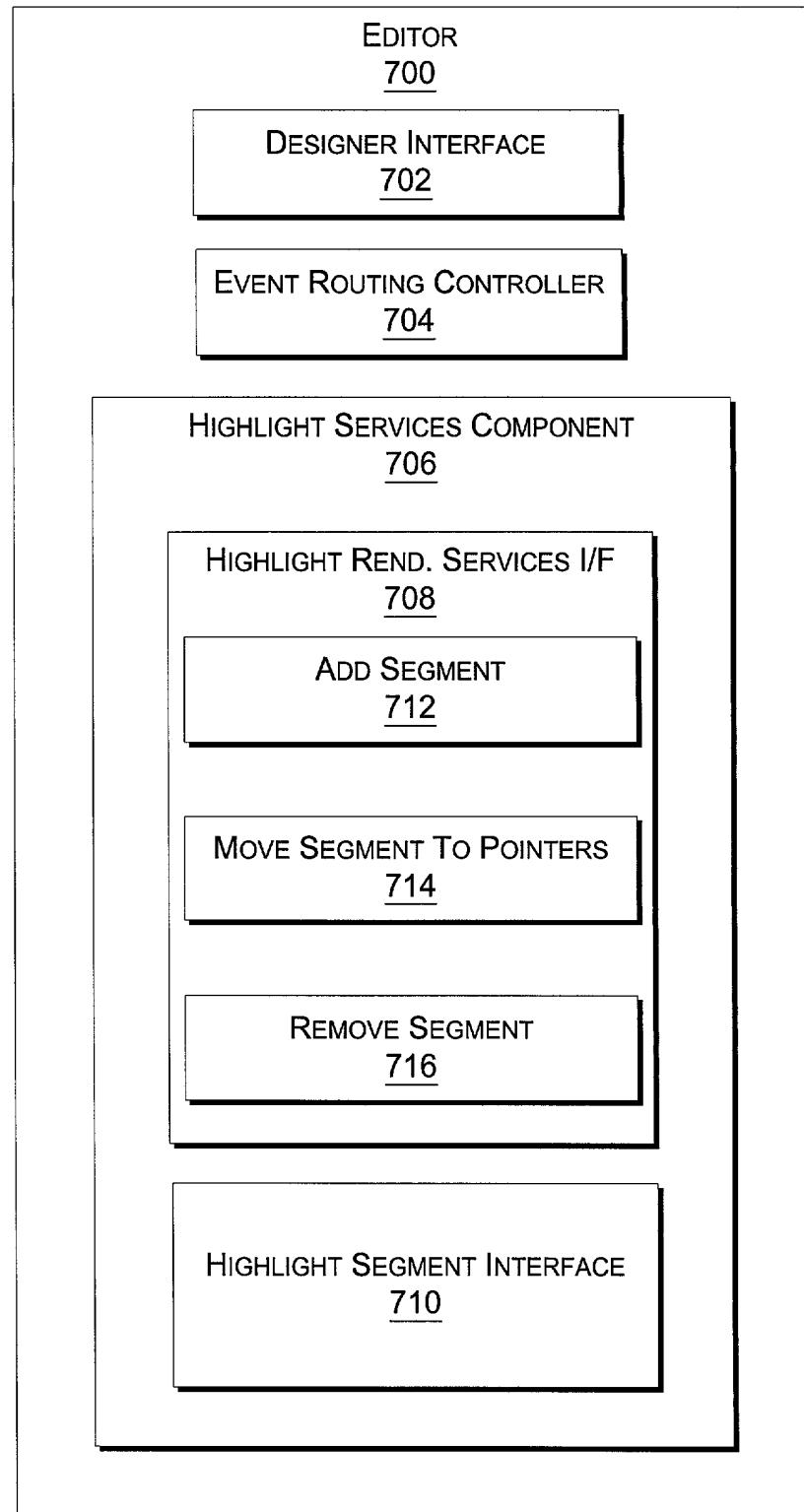


Fig. 7